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(54) [Title of the Invention] Liquid Crystal Display Device

(57) [ABSTRACT]
[Object] The present invention relates to a liquid crystal display device, and more specifically relates to improvement in uniformity of the cell gap of the liquid crystal display device due to the formation of a color filter that is formed by electrodeposition or the like.
[Constitution] A liquid crystal display device made by bonding a second transparent substrate, with an adhesive layer (16), onto a first transparent substrate (11) with a first ITO film (12) selectively formed in parallel on the surface, a color filter (13) formed on the first ITO film (12), a planarization film (14) formed on the upper surface thereof, and a second ITO film (15) formed over the region where the first ITO film (12) is formed, where a dummy ITO film (17) that has the same film thickness as that of the first ITO film (12) is

formed in a region below the adhesive layer (16) where the first ITO film (12) is not formed.

[Scope of Claims]

[Claim 1] A liquid crystal display device configured by bonding a second transparent substrate, with an adhesive layer (16), onto a first transparent substrate (11) with a first ITO film (12) selectively formed in parallel on a surface, a color filter (13) formed on the first ITO film (12), a planarization film (14) formed on an upper surface thereof, and a second ITO film (15) formed over a region where the first ITO film (12) is formed,

characterized in that a dummy ITO film (17) that has a same film thickness as that of the first ITO film (12) is formed in a region below the adhesive layer (16) where the first ITO film (12) is not formed.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application]

The present invention relates to a liquid crystal display device, and more specifically relates to improvement in uniformity of the cell gap of the liquid crystal display device due to the formation of a color filter that is formed by electrodeposition or the like.

[0002]

[Prior Art] A liquid crystal display device according to a conventional example will be described below with reference to the drawings. FIG. 3 is a top view illustrating the configuration of a liquid crystal display device according to a conventional example, and FIG. 4 is a cross-section view along the line C-C of FIG. 3. As shown in FIG. 3, the liquid crystal display device according to the conventional example is a STN (Super Twisted Nematic) liquid crystal dot-matrix display device, which is formed in such a way that a main sealant (6) composed of an epoxy resin is formed on a first transparent substrate (1) with a plurality of ITO films (not shown in the figure) formed in parallel thereon, a second transparent substrate (7) with a plurality of ITO films (not shown in the figure) formed in parallel thereon is formed thereon, and the gap between the first transparent substrate (1) and the second transparent substrate (7), which is surrounded by the main sealant (6), is filled with a liquid crystal (not shown in the figure).

[0003] Details thereof will be described with reference to FIGS. 5 and 6. FIG. 6 is a cross-section view along the line B-B of FIG. 5. As shown in FIG. 6, a first ITO film (2) is formed on the first transparent substrate (1), a color filter (3) is formed thereon by electrodeposition of a pigment, a planarization layer (4) formed with the use of an

epoxy resin is formed, a second ITO film (5) to serve as an actual electrode wiring is formed over the region where the first ITO film (2) is formed, and a main sealant (6) that determines a region for a liquid crystal cell and bonds the first transparent substrate (1) and the second transparent substrate (7) is formed thereon.

[0004] After that, by press bonding of the second transparent substrate (not shown in the figure) to this main sealant (6) and subsequent filling of a liquid crystal, a STN (Super Twisted Nematic) liquid crystal dot-matrix display device is formed.

[0005]

[Problem to be solved by the Invention] However, according to the above-described conventional device, in the region where the liquid crystal cell is formed, the first ITO film (2) is formed only in the top and bottom direction of the liquid crystal cell (the extending direction of the ITO film in FIG. 5), but not formed in the right and left direction. Accordingly, the color filter (3) formed on the ITO film (2) extends only in the vertical direction as shown in FIG. 5 since it is formed by electrodeposition.

[0006] Thus, as shown in FIG. 6, when the level of the main sealant (6A) formed over the region where the color filter (3) is formed, that is, on the top and bottom of the liquid crystal cell is compared with the level of the main sealant (6B) formed over the region where the color filter (3) is not formed, that is, on the right and left of the liquid crystal cell, the main sealant (6A) formed on the top and bottom of the liquid crystal cell is higher by the thickness of the color filter (3) [about 1.2 μm].

[0007] Therefore, as shown in FIG. 6, the level of the formed main sealant (6) varies by location to result in difference in level, and the cell gap at the main sealant (6A) formed on the top and bottom of the liquid crystal cell thus differs from the cell gap at the main sealant (6B) formed on the right ant left thereof to cause a problem that the cell gap is different depending on regions in the same cell.

[0008] The allowance of variation in cell gap of color STN is typically about 0.1 μm. Since the thickness of the color filter is about 1.2 μm, the difference caused by the cell gap regions is not negligible. In particular, in STN liquid crystal display devices, problems in image display occur notably, such as color shading caused by interference color during a non-lighting period and display unevenness caused by difference in Vth during a lighting period.

[0009]

[Means for Solving the Problem] The present invention has been achieved in view of the above-described conventional drawbacks, and as shown in FIG. 1, provides a liquid crystal display device configured by bonding a second transparent substrate, with an adhesive layer (16), onto a first transparent substrate (11) with a first ITO film (12)

selectively formed in parallel on the surface, a color filter (13) formed on the first ITO film (12), a planarization film (14) formed on the upper surface thereof, and a second ITO film (15) formed over the region where the first ITO film (12) is formed, where the cell gap is allowed to be kept constant in each forming region in the liquid crystal cell by forming a dummy ITO film (17) that has the same film thickness as that of the first ITO film (12) in a region below the adhesive layer (16) where the first ITO film (12) is not formed.

[0010]

[Operation] According to the liquid crystal display device of the present invention, as shown in FIG. 1, the dummy ITO film (17) that has the same film thickness as that of the first ITO film (12) is formed in the region below the right and left adhesive layer (16B), which is a region where the first ITO film (12) is not originally formed. Therefore, since the dummy ITO film (17) is formed also in the region below the adhesive layer (16) where no first ITO film (12) used to be formed, the pigment is deposited also on the dummy ITO film (17) under the same condition as that for the first ITO film (12) to form the color filter (13) that has the same film thickness as that of the color filter (13) formed on the first ITO film (12) in the electrodeposition process for forming the color filter (13).

[0011] Therefore, the color filter (13) that has a uniform film thickness is formed in any region below the adhesive layer (16), whereby eliminating the difference in level caused by the region where the adhesive layer (16) is formed. Accordingly, the cell gap is allowed to be made constant in any region in the same liquid crystal cell, and problems in image display such as a difference in color shading, which are conventionally caused by non-constant cell gaps, are allowed to be prevented as mush as possible.

[0012]

[Embodiment] A method for manufacturing a liquid crystal display device according to an embodiment of the present invention will be described below with reference to the drawings. It is to be noted that FIG. 2 is a cross-section view along the line A-A of FIG. 1. As shown in FIG. 2, the liquid crystal display device according to the present embodiment is provided with a glass substrate (11) with a first ITO film (12) and a dummy ITO film (17) 0.15 μm in film thickness formed on the surface by sputtering or the like with a pitch of about 100 μm, a color filter (13) on the order of 1.2 μm in film thickness formed thereon by electrodeposition of a pigment, a planarization layer (14) on the order of 2 μm in film thickness formed thereon with the use of an epoxy resin, a second ITO film (15) 0.15 μm in film thickness formed thereon to serve as an actual electro wiring, and a main sealant (16) formed thereon.

[0013] After that, by press bonding of an upper glass substrate (not shown in the figure)

to the main sealant (6) on the glass substrate (11) and filling of a liquid crystal into a gap between the upper glass substrate and the glass substrate (11) on the inner side of the region where the main sealant (16) is formed, a STN (Super Twisted Nematic) liquid crystal dot-matrix display device is formed.

[0014] In this case, the first ITO film (12) is not formed in a region below the main sealant formed on the right and left of the liquid crystal cell [hereinafter referred to as the right and left main sealant] (16B), but instead, a dummy ITO film (17) is formed there to have the same pitch (that is, about 100 μm) and the same film thickness (that is, about 0.15 μm) as those of the first ITO film (12).

[0015] Thus, the pigment is deposited also on the dummy ITO film (17) under the same condition as that for the first ITO film (12) to form the color filter (13) that has the same film thickness as that of the color filter (13) formed on the first ITO film (12) in the electrodeposition process for forming the color filter (13), whereby eliminating the conventional difference in level between the main sealant formed on the top and bottom of the liquid crystal cell [hereinafter referred to as the top and bottom main sealant] and the right and left main sealant.

[0016] Accordingly, the cell gap is allowed to be made constant in any region in the same liquid crystal cell, and problems in image display such as a difference in color shading, which are conventionally caused by non-constant cell gaps, are allowed to be prevented as mush as possible. It is to be noted in the present embodiment that the glass substrate (11) is one example of the first transparent substrate and the main sealant (16) is one example of the adhesive layer. In addition, the dummy ITO film (17) is extended to the outside of the display region for electrodeposition in the same way as the first ITO film (12).

[0017] [Effect of the Invention] As described above, according to the liquid crystal display device of the present invention, the dummy ITO film (17) is formed at the same interval as that of the first ITO film (12) in the region below the right and left adhesive layer (16) where the first ITO film (12) is not formed. Therefore, the color filter (13) that has a uniform film thickness is formed in any region below the adhesive layer (16), whereby eliminating the difference in height caused by the region where the adhesive layer (16) is formed.

[0018] Accordingly, the cell gap is allowed to be made constant in any region in the same liquid crystal cell, and problems in image display such as color shading, which are conventionally caused by non-constant cell gaps, are allowed to be prevented as mush as possible.

[Brief Description of the Drawings]

[FIG. 1] a top view illustrating a liquid crystal display device according to an embodiment of the present invention

[FIG. 2] a cross-section view illustrating the liquid crystal display device according to the embodiment of the present invention

[FIG. 3] a top view illustrating a liquid crystal display device according to a conventional example

[FIG. 4] a cross-section view illustrating the liquid crystal display device according to the conventional example

[FIG. 5] a top view illustrating a detailed structure of the liquid crystal display device according to the conventional example

[FIG. 6] a cross-section view illustrating the detailed structure of the liquid crystal display device according to the conventional example

[Explanation of the Reference Numerals and Signs]

(11) glass substrate [first transparent substrate]
(12) first ITO film
(13) color filter
(14) planarization film
(15) second ITO film
(16) main sealant [adhesive layer]
(17) dummy ITO film